

- Pairwise Kendall tau's were calculated to examine station similarities in detail (Table E.15-10). Of the testable correlation coefficients derived, 60% were significant at the 0.05 level. No consistent pattern of similarity among the three stations was detected.
- When stations are ranked by species (Table E.15-11), agreement among species occurs in December of 1975 and 1976. This result was generated by highest abundances occurring at Rocky Point and did not appear to relate to plant effects.

E.15.7. Significance and Critique of Findings

- Spot was the only species that was sufficiently abundant to permit use of parametric statistical analysis. No station differences in abundance were found (i.e., there was no evidence of spot avoiding or being depleted at the plant site during the summer); however, the data were very noisy, and only very large differences in abundance would have been detectable. Also, significant interaction terms make it difficult to interpret the analytical results, since the interactions indicate that the pattern of fish distribution was inconsistent.
- Results of all analyses dealing with community composition revealed no distinctive patterns; that is, samples taken at the plant site did not consistently differ in composition from those taken at reference stations. There was also considerable variability in community composition attributable to time of day and depth of sampling. This variation limited the type of analysis that could be done. In general, summer samples at all stations tended to be very similar when measured by Bray-Curtis similarity, primarily because of the overwhelming dominance of spot. Bray-Curtis similarity also reveals a spatial similarity between the plant site and the reference stations, while the two reference stations, which are farther apart, show less similarity.
- Overall, none of the analyses revealed alterations in fish abundance or community composition that would suggest a plant effect. If plant effects do occur, it appears that their influence is small relative to natural fluctuations in fish abundance and community composition.

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Table E.15-1. Station/sampling-period categories available for analysis when tows are partitioned into inshore/offshore or day/night designations; night tows were made only in 1977.

Station	DATE										
	9-75	12-75	3-76	6-76	8-76	12-76	3-77	5-77	6-77	8-77	9-77
I-RP	X	X	X	X	X	X					
I-PP		X									
I-KB		X	X	X	X	X					
O-RP	X	X	X	X	X	X					
O-PP	X	X	X	X	X	X	X	X	X	X	X
O-KB	X	X	X	X	X	X	X	X	X	X	X
O-PP (night)							X	X	X	X	
O-KB (night)						X	X	X	X	X	

I = inshore PP = Power Plant

O = offshore KB = Kenwood Beach

RP = Rocky Point

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Table E.15-2. Components contributing to variation in spot density measurements from the 1977 samples taken at the offshore power plant and offshore Kenwood Beach stations.

Source of Variation	Number of Levels	Index	Population Size	Model Symbol
Date	4	i	∞	A
Day/night	2	j	2	B
Set	3	m	∞	C
Station	2	k	2	γ
Tows	2	n	∞	D

Variate
Model
$$Y_{ijkmn} = \mu + A_i + \beta_j + \gamma_k + C_m(ijk) + D_n(ijkm) + A\beta_{ij}$$

$$+ AC_{ik} + \beta C_{jk} + A\beta C_{ijk} + \epsilon_o(ijkmn)$$

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Table E.15-3. Expected mean squares for ANOVA of spot density measurements from the 1977 samples taken at the offshore power plant and offshore Kenwood Beach stations.

Source of Variation	Expected MS
Date (i)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\cdot2\cdot2\sigma_i^2$
Day/night (j)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\cdot2\sigma_{ij}^2 + 2\cdot2\cdot4K_j^2$
Station (k)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\sigma_{ik}^2 + 2\cdot2\cdot4K_k^2$
Date x (day/night)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\sigma_{ij}^2 + 2\cdot2\sigma_{ij}^2$
Date x station	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\sigma_{ik}^2 + 2\cdot2\sigma_{ik}^2$
Station x (day/night)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\cdot4K_j^2$
Station x date x (day/night)	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk) + 2\sigma_{ijk}^2$
Sets (m) within factors	$\sigma_{\epsilon}^2 + 2\sigma_m^2(ijk)$
Tows within sets	σ_{ϵ}^2

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Table E.15-4. Results of ANOVA on log-transformed spot data from 1977.

Source of Variation	df	Sum of Square	Mean Square	F _s	F _{0.05[v₁, v₂]}}	F _{0.01[v₁, v₂]}}
Dates	3	93.001	31.004	135.270**	2.90	4.46
Day/night	1	4.036	4.035	1.234	10.13	34.12
Station	1	0.095	0.095	0.196	10.13	34.12
Date x (day/night)	3	9.814	3.271	14.273**	2.90	4.46
Date x station	3	1.453	0.485	2.114	2.90	4.46
Station x (day/night)	1	1.150	1.150	5.017*	4.15	7.50
Date x station x (day/night)	3	5.345	1.781	7.773**	2.90	4.46
Sets within factors	32	7.334	0.230	2.980**	1.70	2.11
Tows within sets (error)	48	3.693	0.077			

* P ≤ 0.05

** P ≤ 0.01

Table E.15-5. Geometric cell means from ANOVA of spot densities.

	<u>DAY</u>	<u>NIGHT</u>
<u>MAY 1977</u>		
Offshore power plant	20.045	4.481
Offshore Kenwood Beach	49.822	2.803
<u>JUNE 1977</u>		
Offshore power plant	3,505.048	2,790.873
Offshore Kenwood Beach	9,093.478	3,685.446
<u>AUGUST 1977</u>		
Offshore power plant	867.902	694.880
Offshore Kenwood Beach	81.423	1,335.623
<u>SEPTEMBER 1977</u>		
Offshore power plant	5,807.173	152.820
Offshore Kenwood Beach	702.892	491.400

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Table E.15-6. Wilson's ANOVA of spot densities at three Calvert Cliffs stations for four summer dates in 1977, with day and night trawls.

Source of Variation	df	χ^2	Probability
Date	3	48.813	0.000
Day/night	1	0.042	0.838
Station	1	0.375	0.540
Date x (day/night)	3	14.131	0.003
Date x station	3	0.459	0.928
(Day/night) x station	1	5.044	0.025
(Day/night) x station x date	3	5.127	0.163

Table E.15-7. Bray-Curtis similarity matrices between day and night samples taken at two Calvert Cliffs stations during the summer of 1977.

a) May 1977

offshore power plant (day)

.92	offshore Kenwood Beach (day)	
.57	.64	offshore power plant (night)
.24	.32	.57

offshore Kenwood Beach (night)

b) June 1977

offshore power plant (day)

.98	offshore Kenwood Beach (day)	
.97	.97	offshore power plant (night)
.98	.99	.97

offshore Kenwood Beach (night)

c) August 1977

offshore power plant (day)

.91	offshore Kenwood Beach (day)	
.91	.89	offshore power plant (night)
.99	.90	.92

offshore Kenwood Beach (night)

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Table E.15-7. Continued.

d) September 1977

offshore power plant (day)		
.95	offshore Kenwood Beach (day)	
.95	.98	offshore power plant (night)
.90	.94	.95

offshore Kenwood Beach (night)

Table E.15-8. Bray-Curtis similarity matrices between inshore and offshore day samples taken at two Calvert Cliffs stations in 1975 and 1976.

a) September 1975

inshore Rocky Point

.52	inshore Kenwood Beach	
.80	.71	offshore Rocky Point
.75	.77	.92 offshore Kenwood Beach

b) December 1975

inshore Rocky Point

.22	inshore Kenwood Beach	
.17	.16	offshore Rocky Point
.17	.12	.63 offshore Kenwood Beach

c) March 1976

inshore Rocky Point

.28	inshore Kenwood Beach	
.44	.18	offshore Rocky Point
.77	.22	.32 offshore Kenwood Beach

Table E.15-8. Continued.

d) May 1976

inshore Rocky Point

.85	inshore Kenwood Beach	
.81	.95	offshore Rocky Point
.81	.96	.99

offshore Kenwood Beach

e) September 1976

inshore Rocky Point

.96	inshore Kenwood Beach	
.97	.98	offshore Rocky Point
.96	.97	.97

offshore Kenwood Beach

f) December 1976

inshore Rocky Point

.03	inshore Kenwood Beach	
.16	.01	offshore Rocky Point
.22	.02	.23

offshore Kenwood Beach

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Table E.15-9. Kendall's coefficient of concordance among ranking of species by three Calvert Cliffs stations: (i) offshore power plant, (ii) offshore Rocky Point, and (iii) offshore Kenwood Beach. Probabilities are those of exceeding the calculated χ^2 value if the null hypothesis of independence is correct.

Date	Coefficient of Concordance	χ^2	Probability
Sept. 1975	0.86	18.037	0.011
Dec. 1975	0.78	32.579	0.003
Mar. 1976	0.75	18.013	0.021
June 1976	0.74	26.649	0.009
Aug. 1976	0.63	15.101	0.057
Dec. 1976	0.76	34.203	0.003

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Table E.15-10. Kendall coefficients of rank correlation between finfish assemblages at the Calvert Cliffs stations for 12 sampling dates. The assemblages compared are composed of species found in at least one of the three stations on the given date.

Date	ORP vs OPP	ORP vs OKB	OKB vs OPP
Sept. 1975	0.81*	0.47	0.82*
Dec. 1975	0.35	0.64*	0.82***
Mar. 1976	0.80*	0.40	0.26
June 1976	0.33	0.55*	0.52*
Aug. 1976	0.42	0.47	0.20
Dec. 1976	0.37	0.60**	0.65**
Mar. 1977	N/A	N/A	0.87
May 1977	N/A	N/A	0.85***
June 1977	N/A	N/A	0.81***
Aug. 1977	N/A	N/A	0.72***
Sept. 1977	N/A	N/A	0.90***
Dec. 1977	N/A	N/A	0.85***

- * $P \leq 0.05$
 - ** $P \leq 0.005$
 - *** $P \leq 0.001$
- † number of species ≤ 3

Table E.15-11. Kendall's coefficient of concordance among ranking of three Calvert Cliffs stations [(i) offshore power plant, (ii) offshore Rocky Point, and (iii) offshore Kenwood Beach] by species found in at least one of the stations on the given date. Probabilities (a) are those of exceeding the calculated χ^2 value if the null hypothesis of independence is correct.* Probabilities (b) are those from table R in Siegel (Ref. 152) and are appropriate for $k < 8$.

Date	Coefficient of Concordance	χ^2	Prob (a)	Prob (b)
Sept. 1975	0.030	0.483	0.786	ns
Dec. 1975	0.289	8.680	0.013	0.05
Mar. 1976	0.358	6.438	0.040	ns
June 1976	0.122	3.174	0.204	ns
Aug. 1976	0.098	1.771	0.412	ns
Dec. 1976	0.508	16.246	0.000	0.01

* When the number of observations being ranked is less than 8 (i.e., the number of stations, $k < 8$), then the probability (a) associated with the χ^2 is suspect. Probability (b) is appropriate for k less than 8.

ns - not significant.

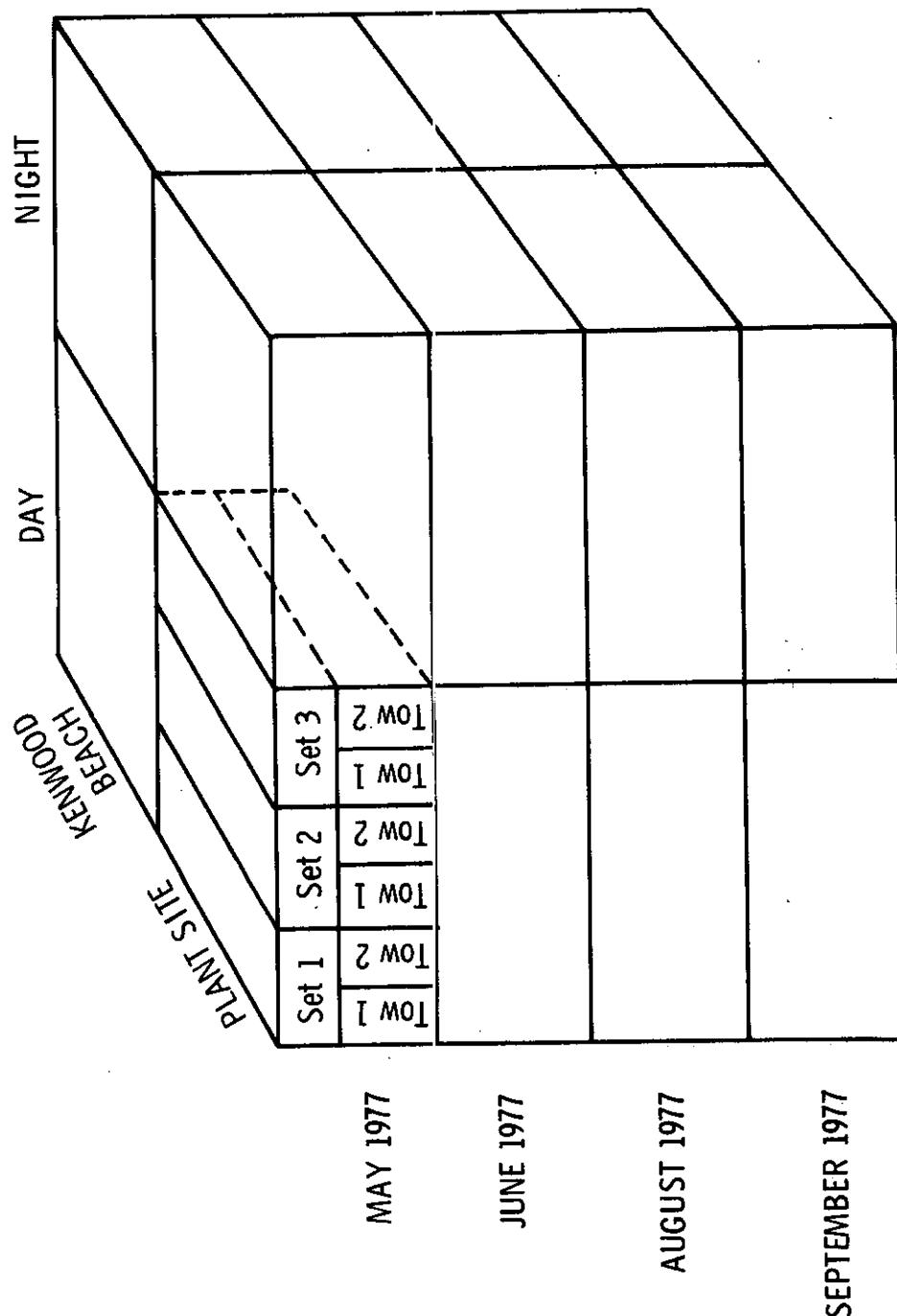


Figure E.15-1. Spot ANOVA data structure. During each month, sampling was done over a 24-hr period so that at each sampling time, 2 tows were made at each location, 3 times during the day and 3 times at night.

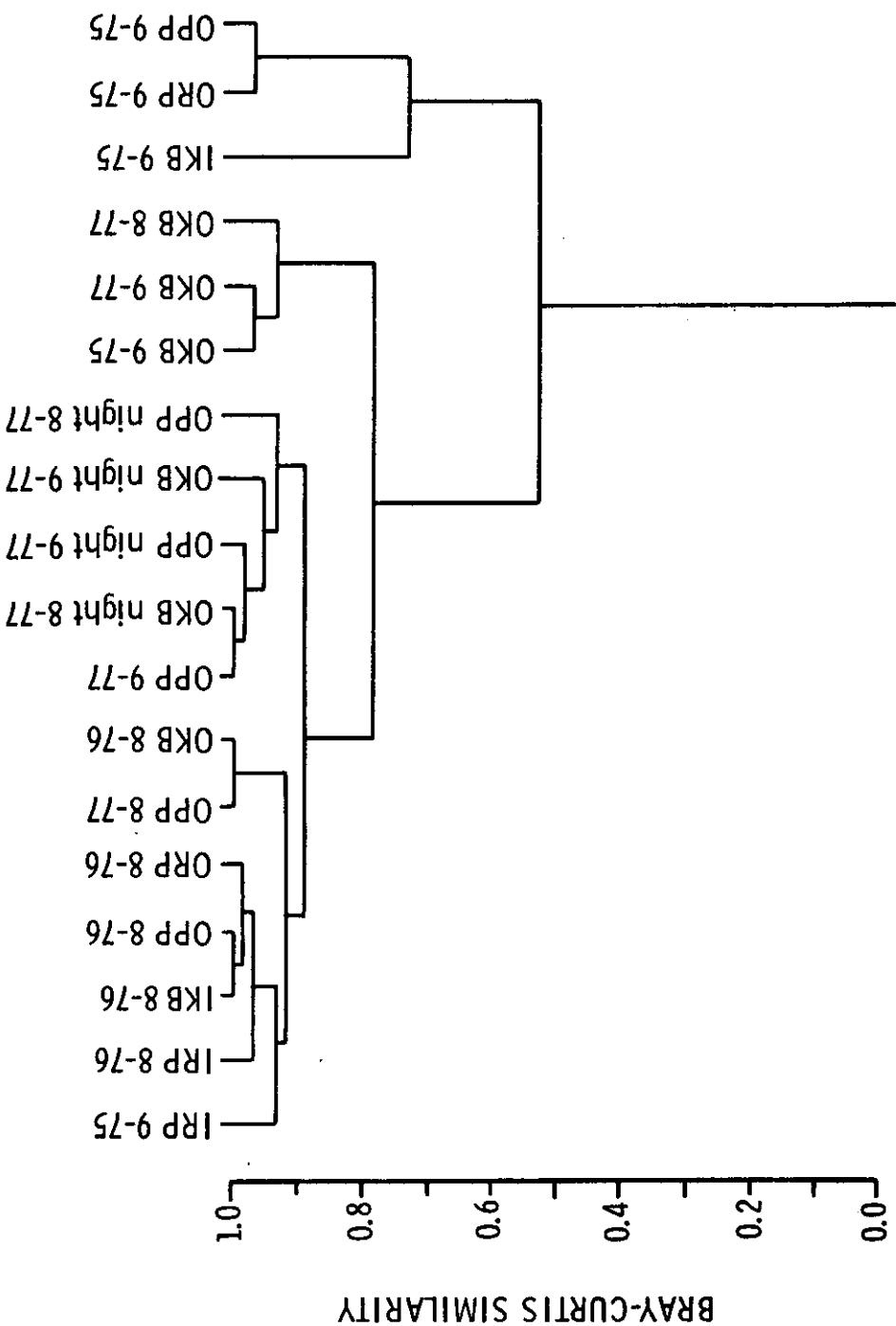


Figure E.15-2. Clustering of late summer samples for Bray-Curtis similarity.
O = Offshore, I = Inshore, RP = Rocky Point, KB = Kenwood Beach, PP = Power Plant.

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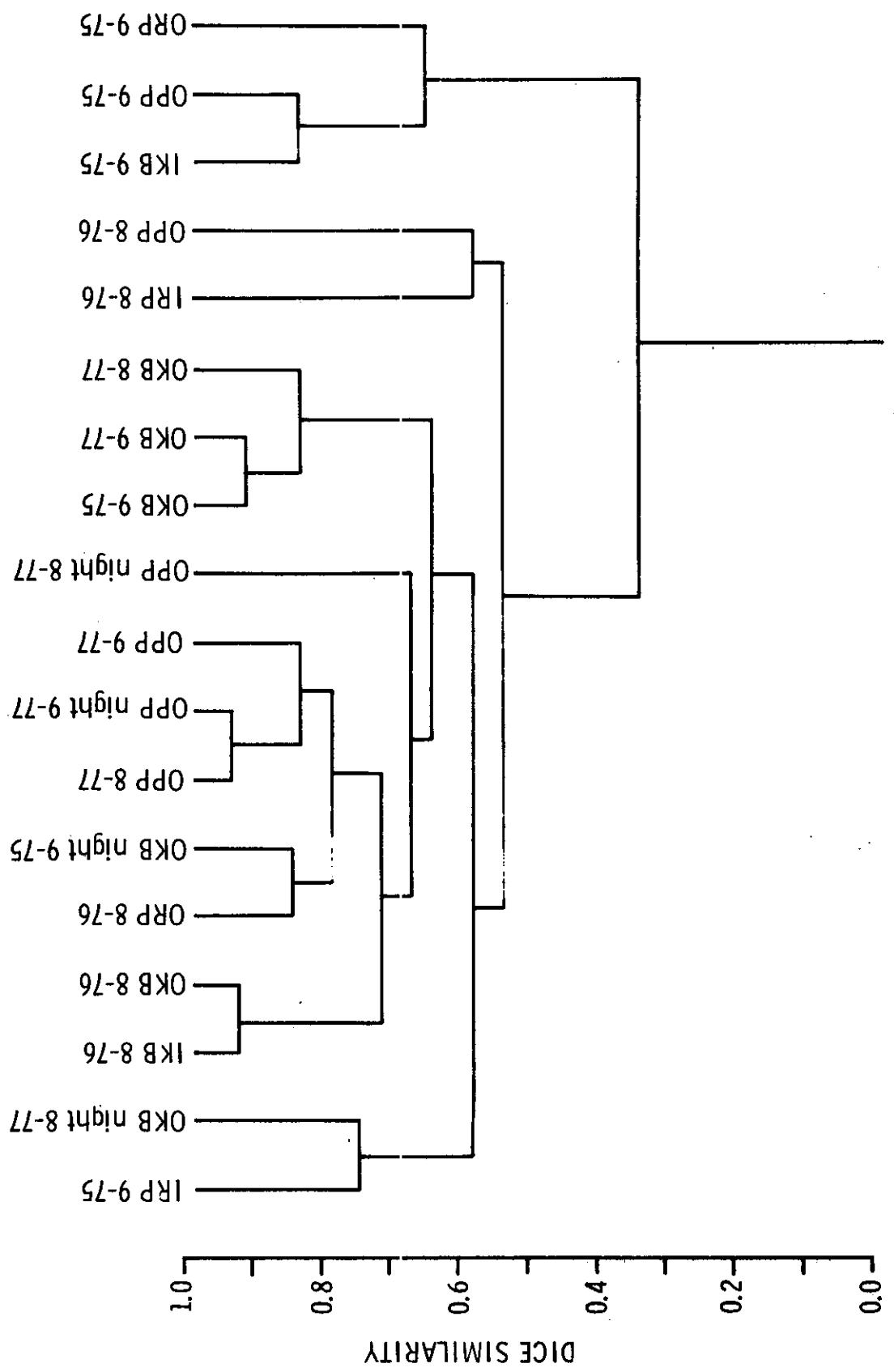


Figure E.15-3. Clustering of late summer samples for Dice similarity (see station codes in Fig. E.15-2).

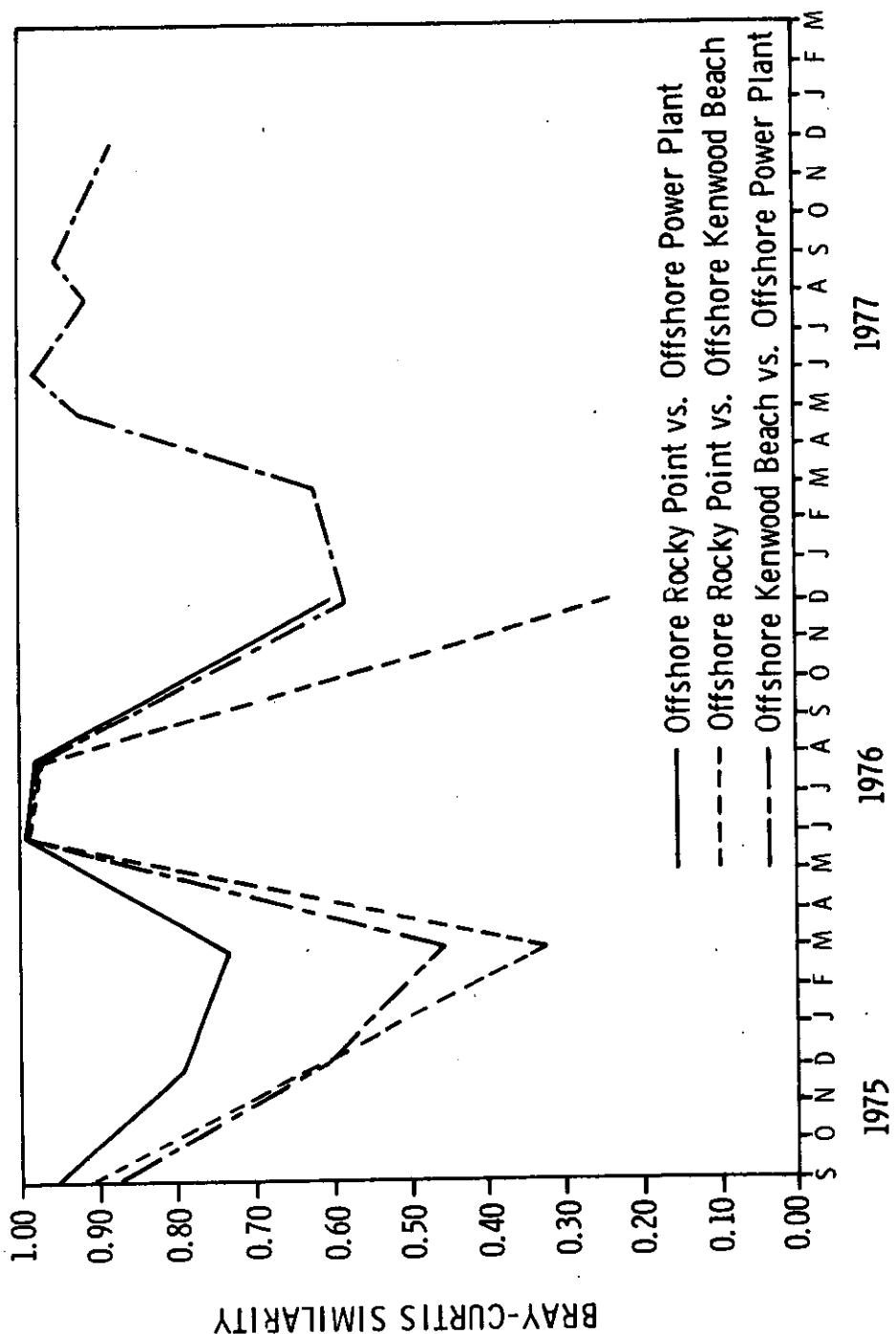


Figure E.15-4. Pairwise similarity of communities at the three sampling locations, by month.

APPENDIX E.16. - ACOUSTIC FINFISH SURVEYS

(MMC)

E.16.1. Objective

To determine whether plant operations have influenced the density and distribution of pelagic fish.

E.16.2. Data Sources

Refs. 141, 142.

E.16.3. Study History

Work in 1975 and 1976 was done concurrently with thermal-plume mapping (see Appendix A.4). The 1977 studies were carried out using a different survey design.

E.16.4. Sampling Methods

- Surveys were conducted with scientific sonar. Returned acoustic signals were recorded on magnetic tape and processed on computer by echointegration to give estimates of biomass per unit volume of water sampled.
- In September and November 1975 and March 1976, surveys covered a series of parallel transects located in the plume vicinity and at reference locations, with repeated runs both day and night at all locations.
- In August 1977, surveys covered three parallel, 10-km transects extending north from the plant, once during the day and four times at night.

E.16.5. Analysis

- For the 1975-1976 data, insufficient numbers of replicate surveys were run to permit statistical comparisons of densities at affected and unaffected locations.
- Transect data from 1977 were analyzed using spectral analysis.

E.16.6. Results

- Fish appeared to avoid the inner plume area somewhat, as shown by September 1975 data.

- Biomass densities inside and outside of the thermal plume in November 1975 and March 1976 are shown in Tables E.16-1 and E.16-2. No consistent differences were observed between densities inside and outside the plume or between the plume and reference areas.
- Mean densities along transect segments during 1977 surveys are shown in Table E.16-3. No consistent differences were evident between densities along plant and reference segments.
- Spectral analyses revealed different types of distribution patterns occurring from day to day and from transect segment to transect segment; however, no consistent pattern relative to the plant location was evident.

E.16.7. Significance and Critique of Findings

No major plant effects were evident in terms of either fish density or fish distribution. However, the nature of the data prevented statistical testing of patterns observed (see Refs. 141, 142), and thus, results are primarily descriptive.

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Table E.16-1. Fish densities at various depths in areas differing in bottom depth, inside and outside the 1°C isotherm (thermal plume) in November 1975 (from Ref. 142).

Run	Depth in Water Column (m)	Bottom Depth < 10 m			Bottom Depth > 10 m		
		Fish Density In Plume (g/m ³)	Fish Density Out of Plume (g/m ³)	Difference (out-in)	Fish Density In Plume (g/m ³)	Fish Density Out of Plume (g/m ³)	Difference (out-in)
A	1-2	0.002	0.007	+ 0.005	---	0.002	---
	2-4	0	0.007	+ 0.007	---	0.108	---
	5-7	---	0.121	- ---	---	1.455	---
B	1-2	0.062	0.021	- 0.041	---	0.018	---
	2-4	0.006	0.227	+ 0.222	---	0.298	---
	5-7	0.007	0.613	+ 0.606	---	0.753	---
C	1-2	1.380	1.441	+ 0.061	1.779	1.090	- 0.689
	2-4	1.402	4.338	+ 2.996	1.002	0.979	- 0.023
	5-7	3.896	15.677	+11.781	0.172	1.300	+ 1.128
D	1-2	0.169	0.042	- 0.127	0.130	0.043	- 0.087
	2-4	0.038	0.650	+ 0.612	0.033	0.451	+ 0.418
	5-7	0.019	12.308	+12.289	0.026	5.506	+ 5.480
E	1-2	1.392	2.372	+ 0.980	2.804	4.865	+ 2.061
	2-4	0.622	1.523	+ 0.901	0.798	4.095	+ 3.297
	5-7	0.124	0.735	+ 0.611	0.079	0.293	- 4.214
F	1-2	0.218	0.252	+ 0.034	2.295	1.845	- 0.450
	2-4	0.314	0.282	- 0.032	1.196	0.855	- 0.341
	5-7	0.572	0.224	- 0.348	0.427	1.03	+ 0.603
G	1-2	16.679	14.043	- 2.636	24.018	7.263	-16.755
	2-4	14.397	5.906	- 8.491	12.976	4.439	- 8.537
	5-7	1.673	2.140	+ 0.467	0.723	1.260	+ 0.537
H	1-2	2.680	4.381	+ 1.701	22.138	4.729	-17.409
	2-4	0.253	6.356	+ 6.103	---	6.872	---
	5-7	0.108	1.409	+ 1.301	---	1.928	---

* Indicates plume was not present.

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Table E.16-2. Fish densities at various depths inside and outside the 1°C isotherm (thermal plume) in March 1976 (from Ref. 142).

	Depth Interval (m)	In Plume	Shallow Density Out Plume (g/m ³)	Diff.	In Plume (g/m ³)	Deep Plume (g/m ³)	Out Plume (g/m ³)
Day AA	1-2	0.028	-		0.002	0.002	
	2-4	0.065	0.084	0.019	-	0.014	
	5-7	0.011	0.067	0.056	-	0.004	
Night BB	1-2	0.142	0.004	0.138	-	0.015	
	3-5	0.303	0.634	0.331	-	0.538	
	5-7	-	-	-	No Data		
Night CC	1-2	-	0.017	-	-	0.019	
	3-5	0.733	0.612	0.121	-	0.407	
	5-7	0.690	0.705	0.015	-	0.473	

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Table E.16-3. Mean areal density (g/m^2) and mean density (g/m^3) derived from acoustic data for the plant site and reference segment along each Calvert Cliffs acoustic transect on six consecutive days in August 1977 (from Ref. 142).

Date	Time of Day		Transect	Mean Areal Density ($\text{g} \cdot \text{m}^{-2}$)		Plant site	Mean Density ($\text{g} \cdot \text{m}^{-3}$)	
	Begin	End		Plant site	Reference		Plant site	Reference
Aug 22	0800	0930	1	16.479	4.927	2.714	1.007	
Aug 22	0930	1100	2	1.331	9.408*	0.206	1.239	
Aug 22	1100	1214	3	4.429	5.869*	0.403	0.568*	
Aug 23	2115	2217	1	9.736	5.243	1.268	1.044	
Aug 23	2217	2330	2	3.561	2.500	0.462	0.317	
Aug 23-24	2330	0003	3	5.414	5.324*	0.582	0.581	
Aug 24	2111	2215	1	1.184	1.633*	0.188	0.368*	
Aug 24	2215	2352	2	2.146*	3.528	0.354	0.460	
Aug 24-25	2352	0107	3	4.395	34.045	0.546	4.176	
Aug 25	0107	0137	2 (Replicate)	N.A.	1.585	N.A.	0.291	
Aug 25	2045	2156	1	2.045	2.861	0.426	0.818	
Aug 25	2156	2318	2	2.776*	3.085*	0.409*	0.418*	
Aug 25-26	2318	0022	3	5.244	15.807	0.557	1.685	
Aug 26	0022	0138	2 (Replicate)	3.713	2.080	0.508	0.286	
Aug 26	2033	2142	1	3.782	1.967	0.629	0.490	
Aug 26	2142	2250	1	6.191*	7.640	0.858*	1.078	
Aug 26-27	2250	0013	3	6.075	7.864	0.647	0.843	
Aug 27	0013	0141	2 (Replicate)	7.194	7.858	0.961	1.120	

* These means are of acoustic series having outlying points (not adjusted). The values of the outliers are given in Table 4 (from Ref. 142).

APPENDIX E.17. - CHESAPEAKE BAY MID-WATER FISH TRAWLING,

JUNE 1970 THROUGH APRIL 1971

(C. Moore, ANSP)

E.17.1. Objective

To identify and characterize mid-water fish populations in the vicinity of the plant.

E.17.2. Data Source

Ref. 27.

E.17.3 Study History

One-year study.

E.17.4. Sampling Methods

- Collections were made with a 10-ft beam trawl with a cod end of 1/2-in stretch mesh.
- Quarterly mid-depth trawling was carried out at 9 stations in the plant vicinity (see Fig. E.17-1).
- Physical and meteorological data were collected prior to each trawl.

E.17.5. Analysis

For each trawl sample, all fish were counted and separated according to species, and 100 of each species were measured for total length.

E.17.6. Results

- A list of the 15 species collected is given in Table E.17-1.
- The number of fish taken quarterly at each station and the number and size range of each species collected is given in Tables E.17-2 and E.17-3, respectively.
- Over 90% of the trawls yielded fewer than 11 fish.
- The bay anchovy (Anchoa mitchilli) made up 99% of the total catch of 3,791 fish.

- o Table E.17-4 compares the number of fish and species collected by mid-water trawl to the numbers taken by bottom trawl at four stations during the same months. The bottom trawl collected 400 times the number of fish and 5 times the number of species than the mid-water trawl.

E.17.7. Significance and Critique of Findings

The low catches reported by this study appear to be the result of poor sampling. Acoustic surveys (Appendix E.16) and other trawl surveys (Appendix E.13) demonstrate that the abundance of pelagic fish in the Calvert Cliffs area is high.

Table E.17-1. Species list of all fishes caught, together with their common names (from Ref. 27).

<u>Common Name</u>		<u>Scientific Name</u>
Bay anchovy	-	<u>Anchoa mitchilli</u>
American eel	-	<u>Anguilla rostrata</u>
Spotted hake	-	<u>Urophycis regius</u>
Sea horse	-	<u>Hippocampus hudsonius</u>
Northern pipefish	-	<u>Syngnathus fuscus</u>
Striped bass	-	<u>Morone saxatilis</u>
Weakfish	-	<u>Cynoscion regalis</u>
Spot	-	<u>Leiostomus xanthurus</u>
Atlantic croaker	-	<u>Micropogon undulatus</u>
Northern searobin	-	<u>Prionotus carolinus</u>
Southern harvestfish	-	<u>Peprilus alepidotus</u>
Atlantic silverside	-	<u>Menidia menidia</u>
Winter flounder	-	<u>Pseudopleuronectes americanus</u>
Hogchoker	-	<u>Trinectes maculatus</u>
Oyster toadfish	-	<u>Opsanus tau</u>

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Table E.17-2. Number of fish collected quarterly at nine stations on Chesapeake Bay, June 1970 through April 1971 (from Ref. 27).

Station Number	June	September	December	April
1	5	0	0	0
2	11	0	2	0
3	4	0	0	0
4	2178	121	0	0
5	0	0	1	2
6	1433	7	0	0
7	1	2	1	0
8	0	0	1	0
9	1	0	0	1
Total	3633	130	5	3

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Table E.17-3. Total number and size range (centimeters) of each species collected quarterly from nine stations on Chesapeake Bay, June 1970 through April 1971 (from Ref. 27).

		June	Sept	Dec	Apr
<u>Anchoa mitchilli</u>	Number Range	3609 5.5-9.0	125 5.0-7.0	2 7.0	
<u>Anguilla rostrata</u>	Number Range		5 51.0-63.0	1 77.0	
<u>Urophycis regius</u>	Number Range				1 6.5
<u>Hippocampus hudsonius</u>	Number Range				1 7.0
<u>Syngnathus fuscus</u>	Number Range		3 15.0-19.0		
<u>Morone saxatilis</u>	Number Range				1 11.5
<u>Cynoscion regalis</u>	Number Range		2 2.0-3.5		
<u>Leiostomus xanthurus</u>	Number Range		1 19.0		
<u>Micropogon undulatus</u>	Number Range			1 2.0	
<u>Prionotus carolinus</u>	Number Range		1 6.0		
<u>Peprius alepidotus</u>	Number Range			2 6.0-9.5	
<u>Menidia menidia</u>	Number Range		1 3.5		1 9.0
<u>Pseudopleuronectes americanus</u>	Number Range		6 3.5-8.0		
<u>Trinectes maculatus</u>	Number Range		5 12.0-14.0		
<u>Opsanus tau</u>	Number Range			3 5.0-6.0	
Total		3633	130	5	3

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Table E.17-4. Comparison of the number of fish and species collected from four locations during the same months by fifteen-minute mid-water trawls and thirty-minute bottom trawls, June 1970 through April 1971 (from Ref. 27).

Station Number (see Figure 1)		June			September			December			April			Total			
		Mid-Water Bottom		Mid-Water	Bottom		Mid-Water	Bottom		Mid-Water	Bottom		Mid-Water	Bottom	Mid-Water		Bottom
1	No. of fish	5	0	0	85	0	313	0	0	4	5	402	1	10	5	402	10
	No. of species	1	0	0	5	0	7	0	0	2	1						
3	No. of fish	4	31	0	1515	0	201	0	0	6	4	1753	2	13	4	1753	13
	No. of species	2	1	0	5	0	8	0	0	4	2						
5	No. of fish	0	22	0	1665	1	520	2	2	11	3	2231	3	16	3	2231	16
	No. of species	0	1	0	7	1	9	2	2	7	2						
E-191	No. of fish	1	174	0	456	0	500	0	0	66	1	1196	1	18	1	1196	18
	No. of species	1	8	0	7	0	8	0	0	7	1						
Total	No. of fish	10	227	0	3721	1	1544	2	2	90	13	5582	5	23	13	5582	23
	No. of species	3	8	0	9	1	13	2	2	12	2						

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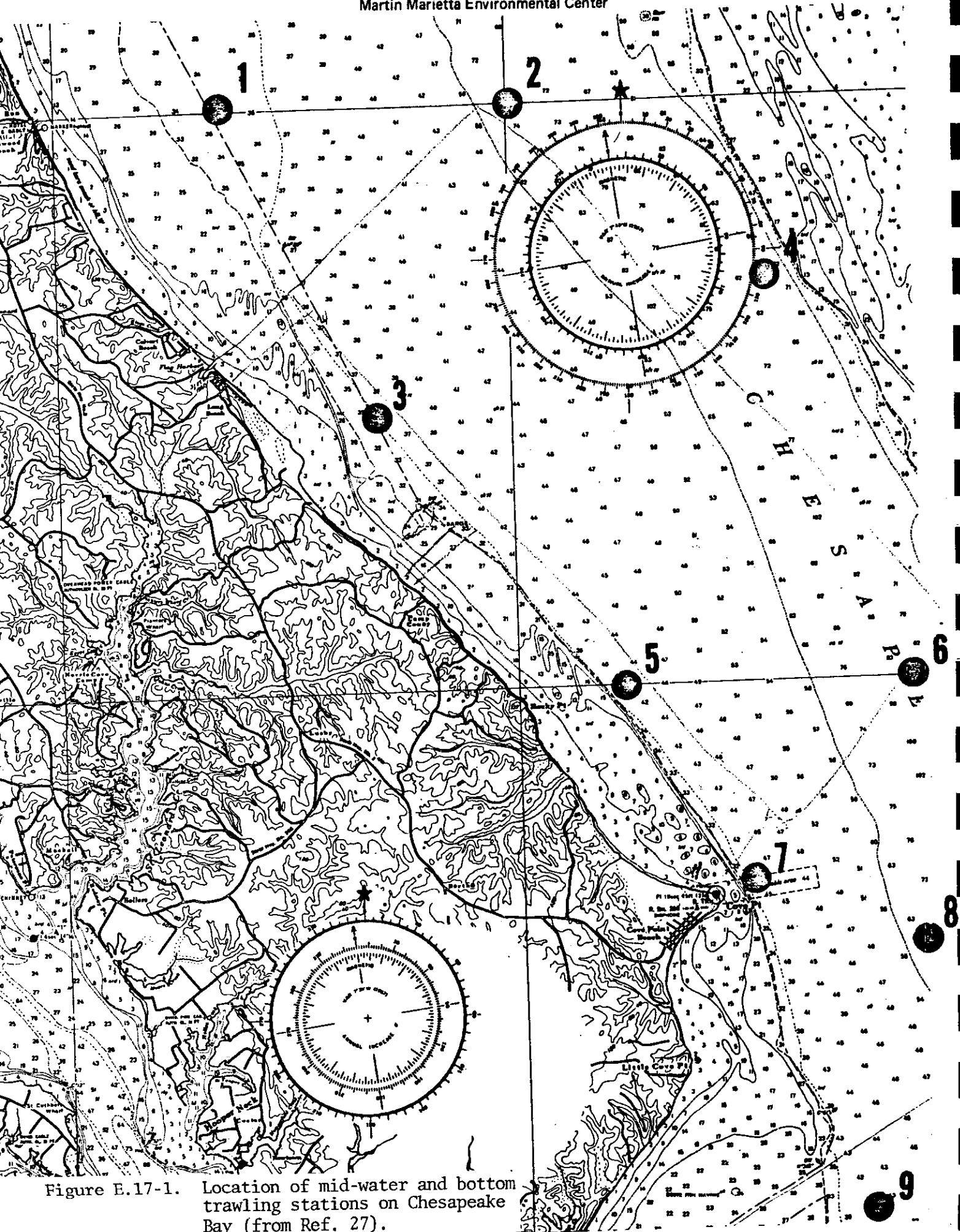


Figure E.17-1. Location of mid-water and bottom trawling stations on Chesapeake Bay (from Ref. 27).

APPENDIX E.18. - CHESAPEAKE BAY SHORE-ZONE FISH SURVEY

(ANSP)

E.18.1. Objective

To investigate the general population structure and various life history aspects of the shore-zone fish community in the vicinity of the plant site.

E.18.2. Data Sources

Refs. 72-75, 165.

E.18.3. Study History

The survey was carried out from 1971 to the present, but results available for this report cover only February 1971 through December 1974 and the entire 1979 period.

E.18.4. Sampling Methods

- Monthly shore seining was carried out at Kenwood Beach, Long Beach, the plant site, and Rocky Point (stations 1-4, respectively). A plant discharge station was added in 1975. Collections were made with a fifty-foot bag seine, covering 7,850 square feet of area with each haul. Temperature, salinity, and tidal stage were recorded prior to each collection.
- All fish collected at each station were counted and separated according to species, and the total lengths of 50 individuals of each species were recorded.

E.18.5. Analysis

Numbers of species and abundances were tabulated and graphed; data from 1979 were analyzed using median polishes.

E.18.6. Results

- Occurrence and total numbers of each species collected from all stations are given in Tables E.18-1 through E.18-4, for 1971 through 1974.
- Among the most abundant species caught throughout the study were the bay anchovy (Anchoa mitchilli), Atlantic menhaden (Brevoortia tyrannus), and Atlantic silverside (Menidia menidia).

- Table E.18-5 compares the relative abundance of each species during 1971 with the total number of each species collected during 1972, 1973, and 1974; Table E.18-6 shows station data from 1979.
- The numbers of species taken monthly from each station during 1971 through 1973 are depicted in Fig. E.18-1.
- No one station consistently yielded a higher or lower number of species. Table E.18-7 presents the number of species taken from each station during four of the sampling years.
- Similar numbers of individuals and species were taken during both day and night seining.
- Results of 1979 data analyses (Table E.18-8) show no consistent differences in fish abundance among stations.

E.18.7. Significance and Critique of Findings

- Of the four most abundant species, three (spot, bay anchovy, and Atlantic menhaden) are not solely shore-zone fishes; these three species also were dominant in offshore trawl surveys.
- Atlantic silverside is the only true shore-zone species taken, and it had fairly low abundance.
- The data show that the shore-zone fish community near Calvert Cliffs is very limited; thus, plant impact on this community would have little probability of affecting the Bay ecosystem.
- Since data collected during plant operations (1979) were very variable, the results of analyses are not very meaningful; the data appear to have little value for assessing plant effects.

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Table E.18-1. Occurrence (+) of species taken during one or more months from four stations on the Chesapeake Bay, February through December 1971 (from Ref. 72).

<u>Species</u>	<u>Station</u> <u>1</u>	<u>Station</u> <u>2</u>	<u>Station</u> <u>3</u>	<u>Station</u> <u>4</u>
<u>Alosa aestivalis</u>	+	+	+	+
<u>Alosa pseudoharengus</u>	+	+	+	+
<u>Brevoortia tyrannus</u>	+	+	+	+
<u>Dorosoma cepedianum</u>			+	+
<u>Anchoa mitchilli</u>	+	+	+	+
<u>Anguilla rostrata</u>	+	+		+
<u>Strongylura marina</u>	+	+	+	+
<u>Cyprinodon variegatus</u>	+	+	+	+
<u>Fundulus diaphanus</u>	+	+		+
<u>Fundulus heteroclitus</u>	+	+	+	+
<u>Fundulus majalis</u>	+	+	+	+
<u>Lucania parva</u>		+	+	+
<u>Urophycis regius</u>			+	
<u>Apeltes quadracus</u>	+		+	
<u>Syngnathus fuscus</u>	+	+	+	+
<u>Morone americanus</u>	+	+	+	+
<u>Morone saxatilis</u>	+	+	+	+
<u>Lepomis gibbosus</u>				+
<u>Micropterus salmoides</u>		+		
<u>Pomatomus saltatrix</u>		+	+	
<u>Bairdella chrysura</u>				+
<u>Cynoscion regalis</u>		+		+
<u>Cynoscion nebulosus</u>		+		
<u>Leiostomus xanthurus</u>	+	+	+	+
<u>Menticirrhus americanus</u>	+			+
<u>Sciaenops ocellata</u>	+	+		+
<u>Prionotus carolinus</u>	+	+	+	+
<u>Peprilus alepidotus</u>				+
<u>Mugil curema</u>			+	
<u>Menidia menidia</u>	+	+	+	+
<u>Menidia beryllina</u>	+	+	+	+
<u>Paralichthys dentatus</u>	+			+
<u>Pseudopleuronectes americanus</u>	+	+	+	+
<u>Trinectes maculatus</u>	+	+		+
<u>Gobiesox strumosus</u>	+	+	+	+
<u>Sphaeroides maculatus</u>			+	+
<u>Opsanus tau</u>	+			+
TOTAL NO. SPECIES	25	26	24	31

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Table E.18-2. Total number of each species collected from four stations on Chesapeake Bay, January through December 1972 (from Ref. 73).

		Stations			
		1	2	3	4
<i>Alosa aestivalis</i>		77	61	277	59
<i>Alosa pseudoharengus</i>		1		5	12
<i>Brevoortia tyrannus</i>		1,624	1,435	4,162	55
<i>Dorosoma cepedianum</i>		5	1		
<i>Anchoa mitchilli</i>		1,395	47	1,328	3,108
<i>Anchoa hepsetus</i>		2		1	1
<i>Umbrina pygmaea</i>		1		16	6
<i>Notemigonus crysoleucus</i>			2	2	
<i>Notropis atherinoides</i>		4	9		1
<i>Anguilla rostrata</i>					1
<i>Ictalurus melas</i>		7	12	101	32
<i>Strongylura marina</i>			1		1
<i>Cyprinodon variegatus</i>		1	6	2	2
<i>Fundulus diaphanus</i>					12
<i>Fundulus heteroclitus</i>		3	15		
<i>Fundulus majalis</i>		87	504	7	1
<i>Lucania parva</i>				1	1
<i>Apeltes quadracus</i>			9		
<i>Syngnathus fuscus</i>		13	23	52	5
<i>Morone americana</i>		40	96	17	10
<i>Morone saxatilis</i>		48	28	11	5
<i>Lepomis macrochirus</i>		1	1		
<i>Lepomis gibbosus</i>			3		1
<i>Micropterus salmoides</i>				2	
<i>Perca flavescens</i>		2			
<i>Pomatomus saltatrix</i>		11	11	29	18
<i>Cynoscion regalis</i>					49
<i>Leiostomus xanthurus</i>		133	1,219	249	106
<i>Micropogon undulatus</i>				2	4
<i>Mugil curema</i>		9			
<i>Menidia beryllina</i>		112	250	52	105
<i>Menidia menidia</i>		2,759	5,643	980	990
<i>Paralichthys dentatus</i>				3	
<i>Pseudopleuronectes americanus</i>		4	2	16	1
<i>Trinectes maculatus</i>			3	3	
<i>Gobiesox strumosus</i>		79	8	1	6
<i>Opsanus tau</i>				3	
Total Number of Fish		6,418	9,389	7,322	4,595
No. of Species		24	24	25	28

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Table E.18-3. Total number of each species collected from four stations on Chesapeake Bay, January through December 1973 (from Ref. 74).

	Stations			
	1	2	3	4
<u>Alosa aestivalis</u>	1,383	35	153	8
<u>Alosa pseudoharengus</u>			67	2
<u>Brevoortia tyrannus</u>	10,294	3,900	658	217
<u>Dorosoma cepedianum</u>	1		4	1
<u>Clupea harengus</u>		1	2	
<u>Anchoa mitchilli</u>	18,393	1,292	4,792	11,353
<u>Notemigonus crysoleucas</u>			1	
<u>Anguilla rostrata</u>	2		3	
<u>Strongylura marina</u>		2		2
<u>Cyprinodon variegatus</u>	1	2	1	
<u>Fundulus diaphanus</u>		3		
<u>Fundulus heteroclitus</u>		12		2
<u>Fundulus majalis</u>	11	125	3	3
<u>Lucania parva</u>	2	2		
<u>Apeltes quadracus</u>		1	3	1
<u>Gambusia affinis</u>			1	
<u>Syngnathus fuscus</u>	59	38	72	15
<u>Morone americana</u>	32	2	20	23
<u>Morone saxatilis</u>	1	1	4	5
<u>Lepomis macrochirus</u>			1	
<u>Pomatomus saltatrix</u>	4	4	1	8
<u>Leiostomus xanthurus</u>	313	342	1,555	68
<u>Micropogon undulatus</u>	7		16	0
<u>Sciaenops ocellata</u>	6		2	
<u>Chasmodes bosquianus</u>	1			
<u>Peprius alepidotus</u>				3
<u>Mugil curema</u>			2	3
<u>Menidia beryllina</u>	74	64	149	223
<u>Menidia menidia</u>	1,474	2,787	1,126	1,083
<u>Paralichthys dentatus</u>	5			
<u>Pseudopleuronectes americanus</u>	10	5	2	1
<u>Trinectes maculatus</u>	2	9	8	
<u>Gobiesox strumosus</u>	8	5	2	1
Total number of fish	32,083	8,632	8,648	13,030
Number of species	22	21	25	21

Table E.18-4. Total number of each species collected from four stations on Chesapeake Bay, January 1974 through December 1974
 (from Ref. 75).

<u>Species</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>Total</u>
<u>Menidia menidia</u>	528	460	508	347	1,843
<u>Menidia beryllina</u>	20	33	20	30	103
<u>Morone americana</u>	6		5	7	18
<u>Dorosoma cepedianum</u>	1			3	4
<u>Brevoortia tyrannus</u>	516	697	108	605	1,926
<u>Alosa aestivalis</u>	1	3	65	183	252
<u>Fundulus majalis</u>	12	158			170
<u>Anchoa mitchilli</u>	1,712	1,476	198	1,521	4,907
<u>Morone saxatilis</u>			1	1	2
<u>Micropogon undulatus</u>	60	1	11	25	97
<u>Leiostomus xanthurus</u>	177	55	64	119	415
<u>Syngnathus fuscus</u>	2	1	1		4
<u>Pomatomus saltatrix</u>	17	10	17	48	92
<u>Mugil curema</u>	6	1			7
<u>Strongylura marina</u>	3	11		26	40
<u>Syphurus plagiUSA</u>	18				18
<u>Cynoscion nebulosus</u>	11			1	12
<u>Gobiesox strumosus</u>	80	1	4	2	87
<u>Anguilla rostrata</u>	13		1		14
<u>Pseudopleuronectes americanus</u>	25	43	7	3	78
<u>Trinectes maculatus</u>	14	5			19
<u>Paralichthys dentatus</u>		1			1
<u>Synodus foetens</u>		2			2
<u>Prionotus evolans</u>				1	1
<u>Cyprinodon variegatus</u>				1	1
 Total	3,222	2,958	1,010	2,923	10,113

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Table E.18-5. Total number of each species collected in 1971, 1972, 1973, and 1974 during monthly shore seining at four stations on Chesapeake Bay (from Ref. 75).

<u>Species</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
<u>Alosa aestivalis</u>	++++*	474	1,579	252
<u>Alosa pseudoharengus</u>	+++	18	69	
<u>Brevoortia tyrannus</u>	++	7,276	15,069	1,926
<u>Dorosoma cepedianum</u>	+	6	6	4
<u>Clupea harengus</u>			3	
<u>Anchoa mitchilli</u>	+++	5,878	35,830	4,907
<u>Anchoa hepsetus</u>		3		
<u>Umbra pymaea</u>		1		
<u>Notemigonus crysoleucas</u>		23	1	
<u>Notropis atherinoides</u>		4		
<u>Anguilla rostrata</u>	++	14	5	14
<u>Ictalurus melas</u>		1		
<u>Strongylura marina</u>	+++	152	4	40
<u>Cyprinodon variegatus</u>	+	2	4	1
<u>Fundulus diaphanus</u>	++	11	3	
<u>Fundulus heteroclitus</u>	+++	30	14	
<u>Fundulus majalis</u>	++++	599	142	170
<u>Lucania parva</u>	+	2	4	
<u>Urophycis regius</u>	+			
<u>Apeltes quadracus</u>	+	10	5	
<u>Gambusia affinis</u>			1	
<u>Syngnathus fuscus</u>	+++	93	184	4
<u>Morone saxatilis</u>	++	92	11	2
<u>Morone americana</u>	++	163	77	18
<u>Lepomis macrochirus</u>		2	1	
<u>Lepomis gibbosus</u>	+	4		
<u>Micropterus salmoides</u>	+	2		
<u>Perca flavescens</u>		2		
<u>Pomatomus saltatrix</u>	+	69	17	92
<u>Cynoscion regalis</u>	++	49		
<u>Cynoscion nebulosus</u>	+			12
<u>Leiostomus xanthurus</u>	++++	1,707	2,278	415
<u>Micropogon undulatus</u>		6	31	97
<u>Sciaenops ocellata</u>	+		8	
<u>Bairdiella chrysura</u>	+			
<u>Menticirrhus americanus</u>	+			
<u>Chasmodes bosquianus</u>			1	
<u>Prionotus carolinus</u>	+			
<u>Peprilus alepidotus</u>	++		3	
<u>Mugil curema</u>	+	11	5	7
<u>Menidia beryllina</u>	+++	519	510	103
<u>Menidia menidia</u>	++++	10,372	6,470	1,843
<u>Paralichthys dentatus</u>	+	3	5	1
<u>Pseudopleuronectes americanus</u>	++++	23	18	78
<u>Trinectes maculatus</u>	++	6	19	19

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Table E.18-5. Continued.

<u>Species</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
<u>Gobiesox strumosus</u>	++	95	16	87
<u>Opsanus tau</u>	++	3		
<u>Sphaeroides maculatus</u>	+			
<u>Syphurus plaginsa</u>				18
<u>Synodus foetens</u>				2
<u>Prionotus evolans</u>				1
Total number of fish		27,725	62,393	10,113

*Relative abundance: (+) indicates one to ten specimens were caught, (++) indicates 11 to 100 specimens, (+++) indicates 101 to 1,000 specimens, and (++++) indicates 1,001 to 10,000 specimens were taken.

Table E.18-6. Collections, by species and station, during 1979 seining studies in the shore zone of the Chesapeake Bay in the vicinity of Calvert Cliffs Nuclear Power Plant (from Ref. 165).

Species	KB	LB	PS	RP	PD	Total
<i>Alosa aestivalis</i>		1	8			9
<i>A. pseudoharengus</i>		4	1	1		1
<i>Anchoa hepsetus</i>		21	47	94	8	172
<i>A. mitchilli</i>	2	5	3	4	1	15
<i>Anguilla rostrata</i>	1	311	173	16	166	667
<i>Brevoortia tyrannus</i>		4	40	2	5	46
<i>Cynoscion regalis</i>						6
<i>Cyprinodon variegatus</i>	1		3			3
<i>Dorosoma cepedianum</i>		1	2			3
<i>Fundulus heteroclitus</i>	11	1				12
<i>Fundulus majalis</i>		1				1
<i>Gobiosox strumosus</i>	310	461	108	482	66	1427
<i>Leiostomus xanthurus</i>	4		1		2	7
<i>Membras martinica</i>		3			28	31
<i>Menidia beryllina</i>	148	96	221	88	410	963
<i>M. menidia</i>			3	1		4
<i>Paralichthys dentatus</i>						2
<i>Pomatomus saltatrix</i>			4			9
<i>Pseudopleuronectes americanus</i>	2	1		1		5
<i>Strongylura marina</i>						4
<i>Syngnathus fuscus</i>			1	1	6	9
<i>Trinectes maculatus</i>			2			
Total species	11	14	15	10	12	22
Total fish	483	912	617	690	699	3401

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Table E.18-7. Number of species taken by seining, 1971-1974
(from Ref. 75).

<u>Year</u>		Station			<u>Mean</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	
1971	25	26	24	31	27.5
1972	24	24	25	28	25.2
1973	22	21	25	21	22.0
1974	20	17	14	17	17.0
Mean	22.7	22.0	22.0	24.2	

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Table E.18-8. Median polish tables for the comparison among-months and among-stations for total numbers of fish collected by shore seining in the vicinity of Calvert Cliffs Nuclear Power Plant, Chesapeake Bay, 1979 (from Ref. 165).

MONTH	KB	LB	PS	PD	RP	MEDIAN Month Effect
January	0	0	-10	1	0	-27
March	13	1	-10	0	0	-27
April	74	-16	11	-42	0	16
May	0	201	-189	-47	59	202
June	-48	0	-28	6	164	25
July	16	0	-14	10	-9	0
August	-29	10	0	0	-32	30
September	-87	176	137	0	-62	88
October	-1	0	23	-10	12	-16
November	0	-2	21	22	-7	-20
December	-20	-22	1	194	0	-3
Median Station Effect	0	0	10	0	0	27 Overall Median

The monthly medians and station medians are given in the right and lower margins of the table, respectively, and the residuals are given in the body of the table. As indicated by the statement of the model, the actual fish abundance for any month and station is the sum of the overall median, the month effect, the station effect and the residual value.

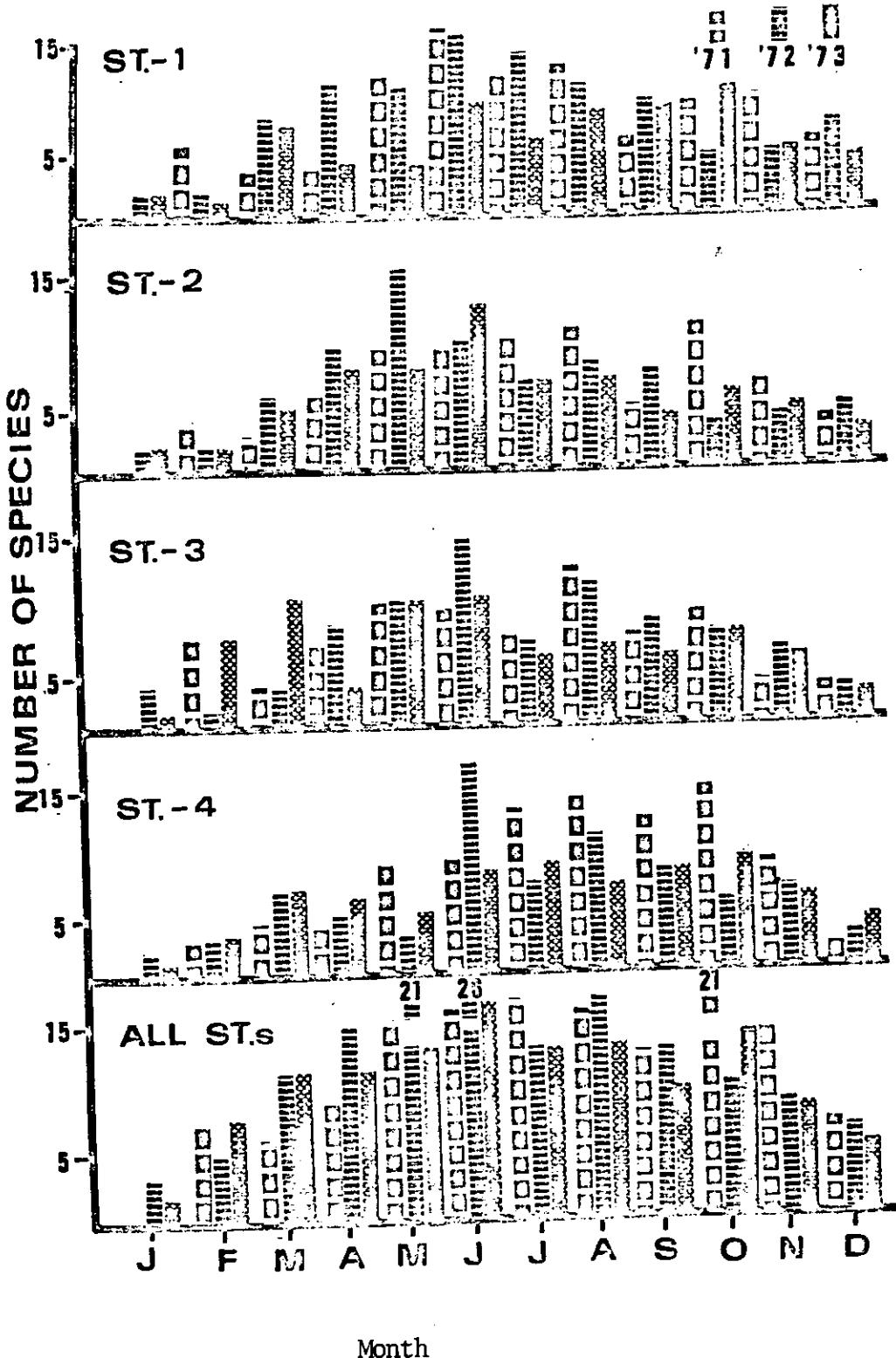


Figure E.18-1. Number of species taken monthly from four shore seining stations on Chesapeake Bay during 1973 compared to the numbers taken during 1971 and 1972 (from Ref. 74).

APPENDIX E.19. - FINFISH STOMACH ANALYSES

(M. Homer and W. Boynton, CBL)

E.19.1. Objective

To determine whether plant operations influence feeding behavior of finfish.

E.19.2. Data Source

Ref. 126.

E.19.3. Study History

One-year study.

E.19.4. Sampling Methods

- Samples were collected at Kenwood Beach and at the plant site in March, May, June, August, September, and December 1977, with a 25-foot otter trawl. Daytime and nighttime tows were made in June, August, and September.
- For species other than spot and anchovy (which dominated the catches), all individuals were saved for stomach analysis; for spot and anchovy, 100 individuals were saved from each trawl sample.
- Food habits data were compiled by size group of predator.
- The "gravimetric method" of Ricker (1971, Ref. 125) was used to quantify stomach contents. Prey items were grouped into taxonomic or trophic categories, counted, and weighed. Each prey item or category was expressed as a percent of the total weight of all food items.
- Reconstructed food item weights were calculated for invertebrate food items by using the mean weight of a representative sample of intact prey item individuals.

E.19.5. Analysis

- Differences in food habits of fish taken at the two stations were tested using paired t-tests at the species level according to size, time of capture (day or night), calendar date, and location (plant site and reference area).

- Food habits for individual species were aggregated according to size and date to obtain estimates of food habits for a species population.
- Food habits of the dominant species' population were aggregated to obtain estimates of fish community food habits.
- Length-weight regressions and standard-length to fork-length conversions were developed for selected species.

E.19.6. Results

- Significant differences in the food habits of spot collected from the two areas are shown in Fig. E.19-1. Polychaetes dominated at Kenwood Beach but not at the plant site. It appears that these differences were related to benthic invertebrate community differences (see Appendix D.1) and not to changes in spot feeding behavior.
- Similar food habit comparisons are given in Fig. E.19-2 for bay anchovy; the only substantial station differences occurred at night in August and September.
- Food habits and feeding behavior were generally similar in both locations for weakfish, hogchoker, winter flounder, summer flounder, and Atlantic croaker.
- Food habits of the demersal fish communities from both locations are presented in Table E.19-1. On a numerical basis, copepods (52%) dominated the diet of Kenwood Beach fish, followed by nematodes (27%) and polychaetes (13%). For plant-site fish, nematodes (66%) dominated, followed by copepods (25%), and polychaetes (7%). On the basis of weight, polychaetes (including Nereis) dominated diets at both locations.
- The mean number and mean weight values of prey items per individual predator were both higher for plant site-fish (Table E.19-2).
- General trends of monthly daytime and nighttime community food habits for the two study areas are given as percentages of diet by weight in Fig. E.19-3.
- A summary of the major daytime and nighttime food habit differences between species and fish communities is given in Table E.19-3.
- Figure E.19-4 depicts the fish community food web structures at each of the study areas.

E.19.7. Significance and Critique of Findings

- Some differences in food habits between stations are evident (more molluscs consumed at the power plant; more Nereis consumed at Kenwood Beach); however, the food web structure is relatively similar at both locations.
- The food habit differences may reflect differences in the benthic community rather than differences in fish feeding behavior (see Appendix D.1).

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Table E.19-1. Community diet of bottom fish collected from Kenwood Beach and in the vicinity of the Calvert Cliffs Power Plant. Data are March through December 1977, combined day/night diet. Values given for numbers and weights are total values, all hauls. Diets are adjusted by standardizing trawl data for unit effort (from Ref. 126).

Kenwood Beach		Power Plant	
Food Item	#	wgt., g	% of diet
			% of body wgt.
Total Number	121,770	1958.233	42.7
Total Number-empty	115,292	1711.515	37.4
Total Weight (g)	984,974.6	344.990	7.5
Total Weight-empty (g)	926,221.6	194.094	4.2
Nereis	47,123	1.764	0.21
Polychaete sp.	639,891	1.414	0.18
Bay Anchovy	465	1.414	0.04
Spot	29	1.232	0.02
Molluscs	232,477	1.230	0.01
Copepods	3,260,433	0.764	<0.01
Atlantic Menhaden	4	0.529	0.01
Weakfish	13	0.419	<0.01
Nematodes	1,716,929	0.354	<0.01
Neomysis	2,414	0.148	<0.01
Amphipods	26,228	0.142	<0.01
Naked Goby	111	0.054	<0.01
Detritus	--	0.040	<0.01
Crangon	448	0.052	<0.01
Ctenophores	--	0.051	<0.01
Ostracods	94,126	0.045	<0.01
Micrura	24	0.027	<0.01
Winter Flounder	2	0.017	<0.01
Diatoms	52,436	0.016	<0.01
Argulus	72	0.019	<0.01
Isopods	9	0.009	<0.01
Filamentous Algae	--	0.005	<0.01

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Table E.19-1: Continued.

<u>Food Item</u>	<u>#</u>	<u>wgt.,g</u>	<u>% of diet</u>	<u>% of body wgt.</u>	<u>#</u>	<u>wgt.,g</u>	<u>% of diet</u>	<u>% of body wgt.</u>
Brachyurans	4	0.001	0.1	0.01				
Molgula	--	--	--	--				
Northern Searobin	--	--	--	--				
Diadumene	--	--	--	--				
Atlantic Croaker	--	--	--	--				
Northern Pipefish	--	--	--	--				
Atlantic Silverside	--	--	--	--				
Palaemonetes	--	--	--	--				
Mud Crab	--	--	--	--				
Coleopterans	--	--	--	--				
Total	6,273,238	4,581.574	100.0	0.49				
					21,681,220	8,629.298	100.0	0.46

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Table E.19-2. Monthly and total mean numbers and weights of prey items in the combined day/night diets of Kenwood Beach (KB) and Calvert Cliffs (CC) demersal fish communities (from Ref. 126).

Month	Prey items per individual predator		\bar{X} (weight, g. wet wt.)
	KB	CC	
May	16.3	28.5	.027
June	60.8	168.9	.040
August	16.0	35.6	.021
September	53.2	285.0	.051
All months ¹	54.4	205.9	.040
			.082

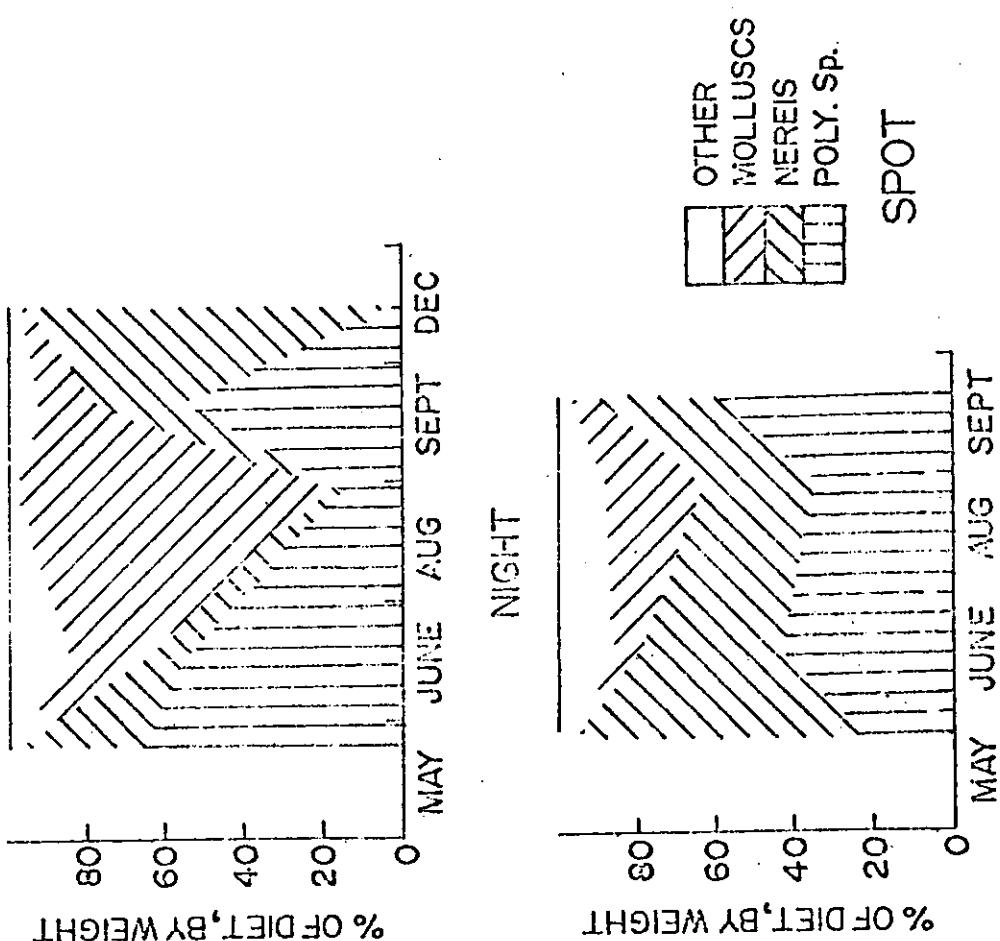
¹Values represent weighted means, adjusted to relative catches.

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Table E.19-3. Summary of major differences in food consumed by dominant demersal fish species collected from Kenwood Beach and Calvert Cliffs during the period from March through December 1977.
 + = percentage of diet, by weight, higher for Kenwood Beach; - = percentage of diet, by weight, higher for Calvert Cliffs; ± = no difference; D = day; N = night (from Ref. 126).

Predator species	Prey Item						% body weight
	<u>Polychaete sp.</u>	<u>Nereis</u>	<u>Mollusc</u>	<u>Amphipod</u>	<u>Copepod</u>	<u>Ostracod</u>	
Spot	-D +N	+D -N	-D -N	-D -N	±D -N	-D -N	+D -N
Bay anchovy		-D -N			+D +N	±D -N	+D -N
Weakfish	±D ±N	±D +N					±D ±N
Atl. croaker	+D,N		-D,N				-D,N ±D,N
Hogchoker	±D,N		±D,N				±D,N
Winter flounder	±D +N	+D -N	±D -N	-D -N			±D -N
Summer flounder						±D,N	±D,N
Community	-D +N	+D -N	-D -N	±D -N	-D -N	±D -N	+D -N

CALVERT CLIFFS
DAY



KENWOOD BEACH
DAY

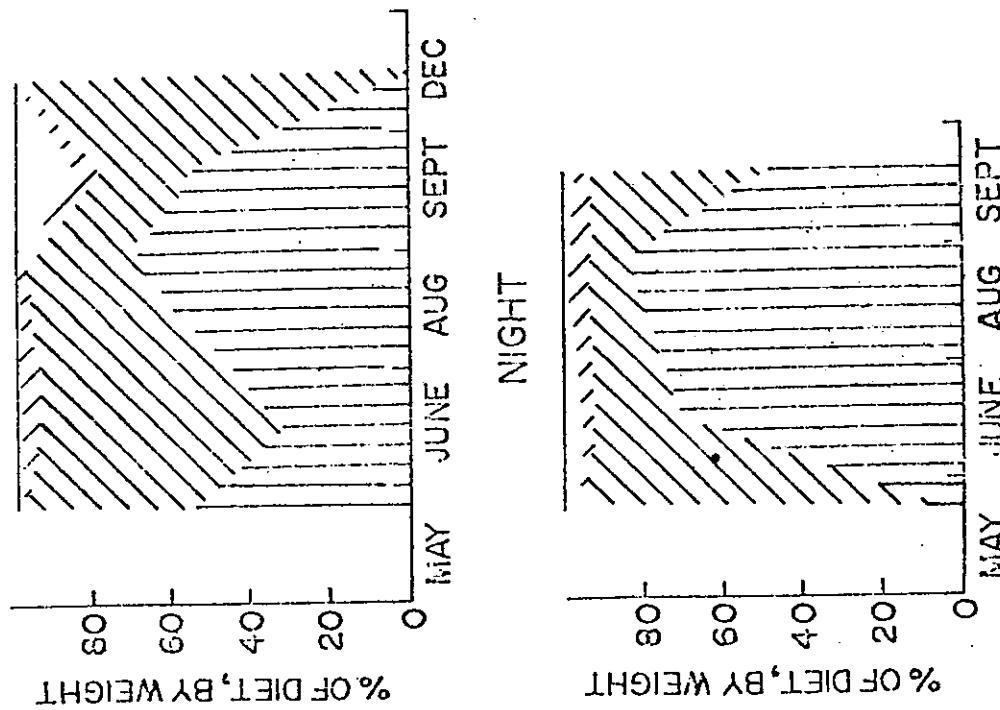


Figure E.19-1. Monthly daytime and nighttime food habits of spot populations collected from Kenwood Beach and Calvert Cliffs. Data are percentages of diet, by weight (from Ref. 126).

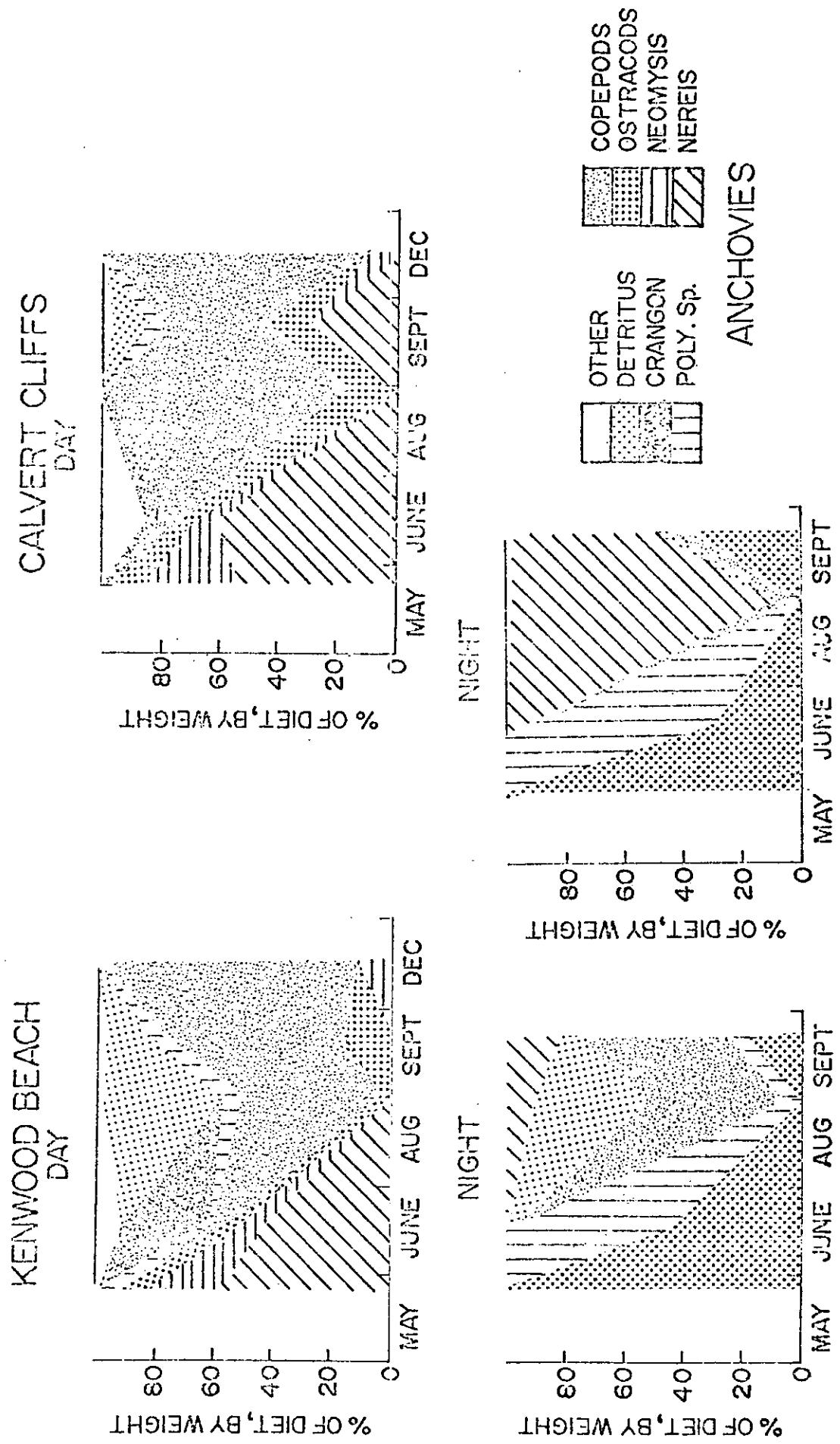
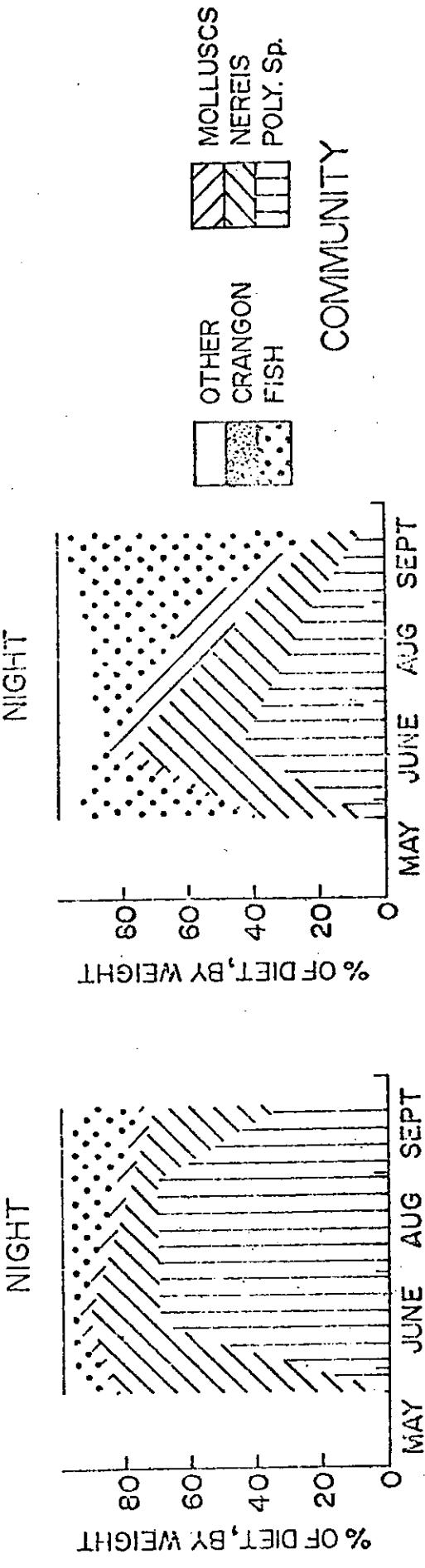
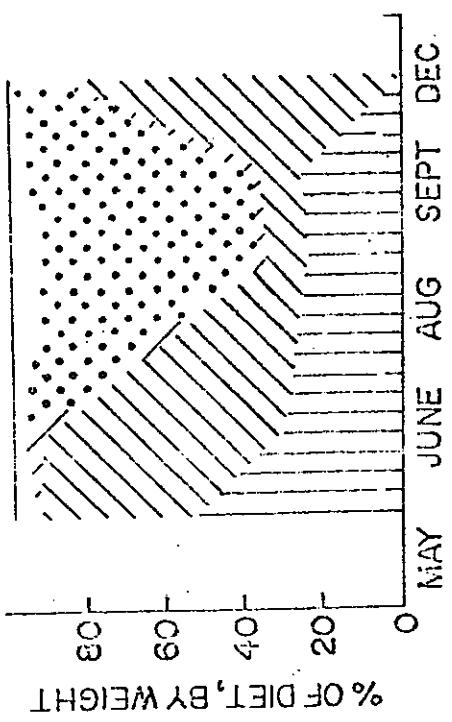


Figure E.19-2. Monthly daytime and nighttime food habits of bay anchovy populations collected from Kenwood Beach and Calvert Cliffs. Data are percentages of diet, by weight (from Ref. 126).

CALVERT CLIFFS
DAY



KENWOOD BEACH
DAY

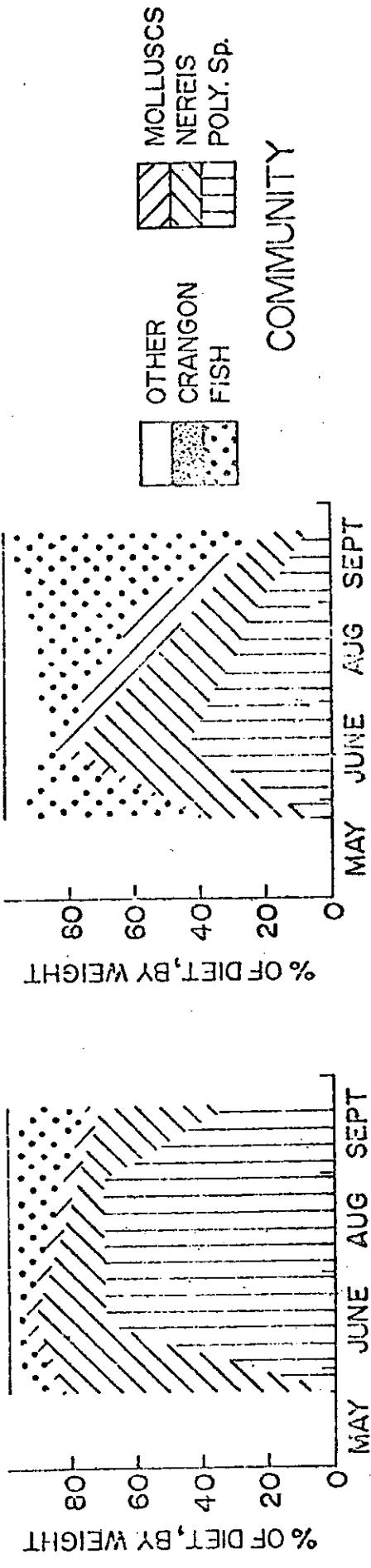
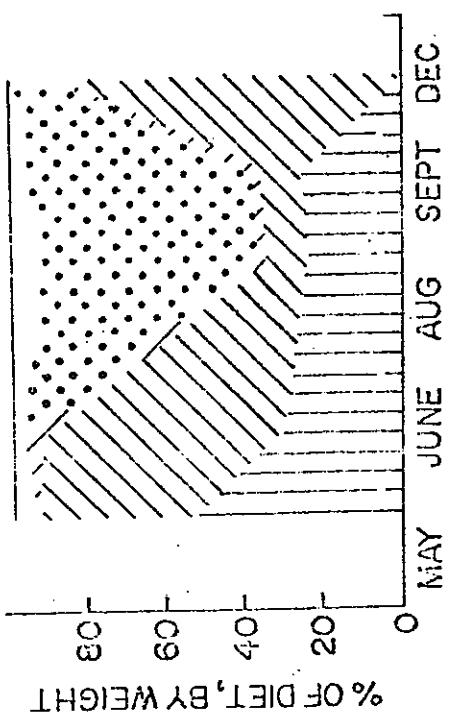


Figure E.19-3. Monthly daytime and nighttime food habits of fish communities collected from Kenwood Beach and Calvert Cliffs. Data are percentages of diet, by weight (from Ref. 126).